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Recovering Germ from Corn Mash Enhances Profitability of Ethanol

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Ethanol is the preferred additive for increasing the level of oxygen in motor fuel. Environmental concerns, the Clean Air Act, and recent regulatory action on methyl tertiary butyl ether – a widely used petroleum-based oxygenating agent – have all contributed to an expanded demand for ethanol as an oxygenate.

For this demand to continue, ethanol must become cost competitive with petroleum-based alternatives. The cost of ethanol is dictated by three primary factors: 1) corn cost, 2) capital facilities cost, and 3) value of processing co-products (non-ethanol process products).

Low corn prices for the past few years have kept ethanol processes competitive.

Similarly, almost 30 years of process design changes with ethanol plants have – along with current tax incentives – allowed ethanol to remain competitive. However, it is unlikely that further large capital savings, capable of offsetting the need for tax incentives, will occur.

The remaining factor – co-product value – appears to be the most likely area in which to improve the profitability of ethanol production from corn. Funded in part by USDA's National Research Initiative (NRI) Competitive Grants Program, researchers at the University of Illinois at Urbana-Champaign, the University of Missouri-Columbia, and the Eastern Regional Research Center of USDA's Agricultural Research Service are examining the possibilities.

USDA-ARS RESEARCHERS JAMES CRAIG (LEFT) AND FRANK TAYLOR EVALUATE THE EFFECT OF REMOVING VALUABLE CO-PRODUCT PRIOR TO FERMENTATION. DATA FROM THIS PILOT-SCALE FERMENTER WILL BE USED FOR SCALING UP TO AN INDUSTRIAL-SIZE FERMENTER.



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WET VS. DRY MILLING

Wet milling is a process to separate corn into its structural components – starch, protein, fiber, and germ (oil).

To produce ethanol from wet milling, the starch portion is cooked, liquefied, saccharified (broken into simple sugars), and fermented into ethanol.

One way to enhance the profitability of dry-grind ethanol is to recover the valuable but nonfermentable germ portion.

Wet milling is a capital-intensive process, costing \$.80 to \$1.20 per bushel at a 20% pretax return on investment (ROI) target. However, it has higher co-product value and lower co-product transportation costs when compared to dry-grind ethanol production.

In the dry-grind ethanol process, the whole kernel is milled finely and cooked. Starch in the resulting mash is liquefied, saccharified, and fermented into ethanol. A major difference in the two processes is that in the dry-grind process more than 25% of the dry solids carried through the process are nonfermentables, such as oil, fiber, protein, and ash.

These nonfermentables provide limited nutritional value to the yeast during fermentation and ultimately pass through the system to form the co-products of corn distillers grain (CDG), corn distillers solubles (CDS), and combined corn distillers grain with solubles (CDGS).

These co-products are used almost exclusively as animal foodstuffs. CDGS currently is selling at a price of \$65 to \$94 per ton, compared to other co-products from wet milling: corn gluten meal (\$240/ton), corn oil (\$480/ton), and corn gluten feed (\$58 to \$80 per ton).

LOWERING COSTS

One way to enhance the profitability of dry-grind ethanol is to recover the valuable but nonfermentable germ portion. In a previous engineering economic analysis of quick germ process and later in collab-

orative work between ARS and the University of Illinois, the researchers demonstrated that removing the oil prior to fermentation could result in a 3- to 12-cent-per-gallon decrease in the cost of processing ethanol.

The savings was due primarily to the increased number of gallons of ethanol generated per fermenter. The value of the recovered oil was important, but net value depended heavily on logistics of shipping the oil to a processor.

In subsequent collaborative work between the University of Illinois and Argonne National Laboratory, the researchers showed that removing the oil also decreased the rate of evaporator fouling. While no economic assessment of the value of this finding was made, industry experts indicate that the value is economically relevant.

In addition, the researchers found that the time to completion of fermentation is decreased by 25% when the germ is removed from mash.

IMPACT

Significant improvements can be made in the cost and efficiency of processing corn into ethanol by separating germ from mash in the dry-grind process. Implementing these findings should aid in making ethanol cost competitive with petroleum-based additives for oxygenating motor fuel, contributing to cleaner-burning fuels and better air quality. ❖

The research reported in this factsheet came out of the Non-Food Characterization/Process/Product Research Program of the Enhancing Value and Use of Agricultural and Forest Products Division of the National Research Initiative Competitive Grants Program. To be placed on the mailing list for this publication or to receive additional information, please contact the NRI (202/401-5022 or NRICGP@reeusda.gov). The factsheet also is accessible via the NRI section of the Cooperative State Research, Education, and Extension Service website (<http://www.reeusda.gov/nri>).

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